

## F . . . ENT COOPERATION TREA

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2/5C24  
Arlington, VA 22202  
ETATS-UNIS D'AMERIQUE  
in its capacity as elected Office

|   |   |
|---|---|
| Date of mailing (day/month/year)<br>16 November 2001 (16.11.01)       |   |
| International application No.<br>PCT/US00/20451                       | Applicant's or agent's file reference<br>99-137           |
| International filing date (day/month/year)<br>27 July 2000 (27.07.00) | Priority date (day/month/year)<br>30 July 1999 (30.07.99) |
| Applicant<br>CHEN, Sherwin, S. et al                                  |   |

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
26 February 2001 (26.02.01)

☐ in a notice effecting later election filed with the International Bureau on:  
\_\_\_\_\_

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

|   |   |
|---|---|
| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland<br>Facsimile No.: (41-22) 740.14.35 | Authorized officer<br>Juan CRUZ<br>Telephone No.: (41-22) 338.83.38 |
|---|---|

# PATENT COOPERATION TREATY

10/01959

PCT

NOTIFICATION THAT DEMAND OR  
ELECTION IS CONSIDERED NOT TO HAVE  
BEEN SUBMITTED OR MADE

(PCT Rule 60.1(c) or 60.2(c) and  
Administrative Instructions, Section 418)

From the INTERNATIONAL BUREAU

To:

Commissioner  
US Department of Commerce  
United States Patent and Trademark Office,  
PCT  
2011 South Clark Place Room CP2/5C24  
Arlington, VA 22202  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

|  |   |
|--|---|
| Date of mailing<br>(day/month/year) 04 April 2002 (04.04.02) |   |
| International application No.<br>PCT/US00/20451              | International filing date<br>(day/month/year) 27 July 2000 (27.07.00) |
| Applicant<br>THE BOEING COMPANY                              |   |

1. ☒ The International Bureau hereby notifies the elected Office that the International Preliminary Examining Authority has declared that the demand relating to the international application has been considered as if it had not been submitted.
2. ☐ The International Bureau hereby notifies the elected Office that it has declared that the notice containing the later election of the (following) State(s) for which the Office acts as elected Office has been considered as if it had not been submitted:

|  |  |
|--|--|
| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland<br>Facsimile No. (41-22) 740.14.35 | Authorized officer<br>Sean Taylor<br>Telephone No. (41-22) 338.83.38 |
|--|--|

# PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

# PCT

## NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

To:

The Boeing Company  
Attn. Galbraith, Ann K.  
P.O. Box 3707, M.S. 13-08  
Seattle, Washington 98124-2207  
UNITED STATES OF AMERICA

Date of mailing  
(day/month/year)

23/07/2001

Applicant's or agent's file reference

99-137

**FOR FURTHER ACTION**

See paragraphs 1 and 4 below

International application No.

PCT/US 00/ 20451

International filing date  
(day/month/year)

27/07/2000

Applicant

THE BOEING COMPANY

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

**Where?** Directly to the International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland  
Facsimile No.: (41-22) 740.14.35

**For more detailed instructions,** see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90b/s.1 and 90b/s.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority

 European Patent Office, P.B. 5818 Patentlaan 2  
NL-2280 HV Rijswijk

Authorized officer

Eric Walsh

## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

#### What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

#### When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

#### How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

#### What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

## NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:  
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:  
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:  
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or  
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:  
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

### "Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

### Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

### Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

|   |   |  |
|---|---|--|
| Applicant's or agent's file reference<br><b>99-137</b>  | <b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. |  |
| International application No.<br><b>PCT/US 00/20451</b> | International filing date (day/month/year)<br><b>27/07/2000</b>   | (Earliest) Priority Date (day/month/year)<br><b>30/07/1999</b> |
| Applicant<br><br><b>THE BOEING COMPANY</b>              |   |  |

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

**FLIGHT INFORMATION DISPLAY**

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

4

☐ None of the figures.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/20451

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 G08G5/02 G08G5/04

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G08G G05D G01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                   | Relevant to claim No. |
|------------|--|-----------------------|
| Y          | US 4 283 705 A (JAMES ROBERT ET AL)<br>11 August 1981 (1981-08-11)<br>figure 1                       | 1-4                   |
| Y          | US 5 445 021 A (CATTOEN THIERRY ET AL)<br>29 August 1995 (1995-08-29)<br>column 2, line 61 - line 65 | 1-4                   |
| A          | DE 35 46 116 A (MUELLER HEINZ)<br>25 June 1987 (1987-06-25)  |                       |
| A          | US 5 289 185 A (RAMIER ALAIN ET AL)<br>22 February 1994 (1994-02-22)                                 |                       |
| A          | EP 0 324 195 A (BOEING CO)<br>19 July 1989 (1989-07-19)  |                       |
|            | -/--   |                       |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*G\* document member of the same patent family

Date of the actual completion of the international search

16 July 2001

Date of mailing of the international search report

23/07/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk

Authorized officer

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/20451

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                         | Relevant to claim No. |
|------------|--|-----------------------|
| A          | US 5 839 080 A (MULLER HANS R ET AL)<br>17 November 1998 (1998-11-17)<br>----                              |                       |
| P,X        | US 5 936 552 A (WICHGERS JOEL M ET AL)<br>10 August 1999 (1999-08-10)<br>the whole document<br>----        | 1-4                   |
| E          | US 6 154 151 A (MCELREATH KENNETH W ET<br>AL) 28 November 2000 (2000-11-28)<br>the whole document<br>----- | 1-4                   |



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/20451

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| US 4283705                                | A | 11-08-1981          | NONE                       |                     |
| US 5445021                                | A | 29-08-1995          | FR 2689231 A               | 01-10-1993          |
| DE 3546116                                | A | 25-06-1987          | NONE                       |                     |
| US 5289185                                | A | 22-02-1994          | FR 2666428 A               | 06-03-1992          |
| EP 0324195                                | A | 19-07-1989          | US 4860007 A               | 22-08-1989          |
|   |   |                     | DE 3850088 D               | 14-07-1994          |
|   |   |                     | DE 3850088 T               | 15-09-1994          |
| US 5839080                                | A | 17-11-1998          | EP 0842396 A               | 20-05-1998          |
|   |   |                     | US 6088634 A               | 11-07-2000          |
|   |   |                     | US 6219592 B               | 17-04-2001          |
|   |   |                     | WO 9705450 A               | 13-02-1997          |
|   |   |                     | US 6122570 A               | 19-09-2000          |
|   |   |                     | US 6138060 A               | 24-10-2000          |
| US 5936552                                | A | 10-08-1999          | NONE                       |                     |
| US 6154151                                | A | 28-11-2000          | NONE                       |                     |

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
22 March 2001 (22.03.2001)

PCT

(10) International Publication Number  
**WO 01/20583 A2**

- (51) International Patent Classification<sup>7</sup>: G08G 5/02
- (21) International Application Number: PCT/US00/20451
- (22) International Filing Date: 27 July 2000 (27.07.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
60/146,489 30 July 1999 (30.07.1999) US  
*30 Jan 02*
- (71) Applicant (for all designated States except US): THE BOEING COMPANY [US/US]; P.O. Box 3707, M/S 13-08, Seattle, WA 98124-2207 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): *✓* CHEN, Sherwin, S. [US/US]; 12601 SE 41st Pl., Apt. C101, Bellevue, WA 98006 (US); *✓* FOX, Julianne, M. [US/US]; The Boeing Company, P.O. Box 3707, M/S 13-08, Seattle, WA 98124-2207 (US); *✓* MOLLOY, Neal, D. [US/US]; 11519 Pine Court, Mukilteo, WA 98275 (US). WIEDEMANN, John [US/US]; 11024 NE 197th St., Bothell, WA 98011 (US).
- (81) Designated States (national): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— Without international search report and to be republished upon receipt of that report.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: VERTICAL SITUATION DISPLAY TERRAIN/WAYPOINT SWATH, RANGE TO TARGET SPEED, AND BLENDED AIRPLANE REFERENCE

(57) Abstract: A flight information display for the flight deck of an aircraft showing a pictorial side view of the flight path or the area directly in front of the aircraft area having a selected distance of at least 0.5 nautical miles, comprising (a) a pictorial representation to scale of the profile of the highest elevations of a swath of terrain along said path or area, (b) an icon positioned on the left or right side of the display representing the aircraft, the altitude of which is to scale with the height of the terrain, and (c) an altitude reference scale; wherein the width of the swath is at least 0.1 nautical miles and no greater than the distance of the minimum accuracy of the means for determining the aircraft's location.

WO 01/20583 A2

5

Vertical Situation

Display Terrain/Waypoint Swath, Range to Target Speed, and Blended  
Airplane Reference.

10 BACKGROUND OF THE INVENTION

In modern flight decks, the primary flight information display (PFD) and the navigation display (ND) are the key displays available for providing situational awareness to the pilot. Although the primary flight information display provides aircraft attitude and performance information through the attitude direction indicator (ADI), airspeed tape, heading and track indicator, and vertical speed indicator (VSI), the performance information is not shown in relation to the aircraft's surroundings. The navigation display provides fairly complete horizontal situational awareness with a top down (map) view of the aircraft and its surroundings. The navigation display tries to address vertical situational awareness through a vertical path deviation indicator, waypoint altitude constraint information, a range to altitude arc, and a selectable terrain picture from a Terrain Awareness and Warning Systems (TAWS). TAWS provides a contour map of surrounding terrain. Due to the display shading limitations and the nature of a top down view display, the contour map can only provide a general awareness of the surrounding terrain height. Also, to avoid pilot complacency and possible false alarms on takeoff and landing, some systems may have a "blackout" elevation below which the display provides no terrain information in normal conditions. Even with

5 these vertical situational awareness features on the navigation display, the information still requires some interpretation, and approach and landing accidents continue to occur. This leaves the pilot with TAWS to provide both horizontal and vertical situational awareness of terrain. The pilot may not be able to perform an optimal vertical maneuver if the pilot is not aware  
10 of the height of the surrounding terrain.

For flight deck displays that show the terrain directly in front of the aircraft, the input for this type of device may be a database of topography information that generates a display based on position information from the aircraft's navigational equipment. However, the display changes with slight  
15 adjustments to the direction of the aircraft, making it appear "noisy". Also, navigational instruments for determining the exact position of an aircraft usually have some degree of error. For example, if the aircraft's automated navigational equipment is only accurate to within 10 nautical miles of the exact location of the aircraft, and the topography display only shows a "line"  
20 of topography directly in front of where the aircraft instruments indicate the aircraft is located, the topography display will be not be accurate as to the topography directly in front of the aircraft if the aircraft's exact position is actually 9.5 nautical miles from the location indicated by the navigation equipment. A presentation of terrain and waypoints along the current track  
25 of the aircraft provides some awareness, but during turns the pilot will not see terrain in the projected path of the turn.

5 To assist pilots with final approach and landing, a localizer and a glideslope indicator may be provided on the electronic attitude director indicator to give the pilot information as to how much the aircraft is deviating from the ideal landing approach angle, as defined by a radio signal from the runway. When the aircraft is not on this ideal path, the flight deck instruments do not indicate the degree of  
10 correction required to return the aircraft to the correct descent path. If the pilot under- or overcorrects the descent angle and cannot position the aircraft onto a suitable landing approach path in a short period of time, the pilot may have to make a decision to abort the landing, circle, and begin another landing approach. A system that gives the pilot better information about the current relationship between  
15 the aircraft and the ideal descent and landing approach path will aid the pilot..

At various times during ascent and descent of an aircraft, it may be necessary for the aircraft to reach a target speed by the time the aircraft reaches a particular geographic point. The airspeed tape on the primary flight information display indicates current and selected airspeeds, but the pilot has  
20 to judge how long it will take to achieve the selected airspeed. The pilot then needs to calculate how far the aircraft will travel before the target speed is achieved. These calculations and estimations may not be very precise and may distract the pilot from performing other duties connected with flying the aircraft and maintaining an accurate mental picture of the situation.

25 For many of the flight information displays in the cockpit, the reference mark by which the instrument is read is either fixed with a moving scale to indicate the value of parameter (for example, an altimeter tape) or

5 the reference mark moves with respect to a fixed scale (for example, a vertical speed indicator). If the reference aircraft symbol on a vertical profile display (VPD) is fixed near the bottom of the display and the aircraft is in a descent, the resolution of the display for that range of altitudes will be insufficient to provide the pilot with any increased awareness of the terrain  
10 the aircraft is approaching. Similarly if the aircraft symbol is fixed at the top of the display and the aircraft is climbing, resolution will be insufficient to increase the pilot's awareness of the airplane's relationship with the terrain ahead.

One known type of vertical display provides a terrain picture for the  
15 navigation displays, EHSIs, and standalone weather radar display units.

Another known vertical profile display depicts the flight plan in an along flight plan presentation. The waypoints are positioned relative to each other and not on an absolute scale (For example, if waypoint A is at FL390 and waypoint B has an altitude constraint of FL410, then waypoint A will be at a  
20 position on the display lower than waypoint B, but otherwise the vertical position of the points will not correlate to any absolute scale). A display that provides better vertical flight situation awareness to the pilot would be desirable.

## 25 BRIEF SUMMARY OF THE INVENTION

In one aspect, this invention is a flight information display for the flight deck of an aircraft showing a pictorial side view of the flight path or the area directly in front of the aircraft area having a selected distance of at least 0.5 nautical miles,

5 comprising (a) a pictorial representation to scale of the profile of the highest elevations of a swath of terrain along said path or area, (b) an icon positioned on the left or right side of the display representing the aircraft, the altitude of which is to scale with the height of the terrain, and (c) an altitude reference scale;

wherein the width of the swath is at least 0.1 nautical miles and no greater  
10 than the distance of the minimum accuracy of the means for determining the aircraft's location.

In another aspect, this invention is a flight information display for the flight deck of an aircraft showing a side view of the landing approach for the aircraft on a runway, comprising (a) a pictorial representation to scale of the profile of the current  
15 projected path of the descent of the aircraft, (b) a pictorial representation to the same scale of the profile of the vertical glide path of the approach, (c) an icon positioned on the left or right side of the display representing the aircraft; the altitude of which is depicted to the same scale, and (d) an altitude reference scale.

In a third aspect, this invention is a flight information display for the  
20 flight deck of an aircraft comprising (a) a reference point or icon representing the current location of the aircraft, (b) a pictorial representation of at least 0.5 nm of the profile of the projected flight path of the aircraft, (c) an icon showing the location at which the aircraft will reach a target speed based on its current speed and acceleration. This display provides an  
25 indication of where in the vertical plane and along the flight path the target speed will be achieved.

5           In a fourth aspect, this invention is a flight information display for the flight deck of an aircraft, which comprises (a) an icon having a fixed position on the right or left side of the display representing the aircraft; (b) a vertical altitude scale which changes as the altitude of the aircraft changes so that the altitude number horizontally aligned with the aircraft icon is the current altitude of the aircraft and  
10   the aircraft icon is located vertically along the altitude reference scale while always being in view, , and (c) a pictorial representation of a lateral view of any terrain directly in front of the aircraft.

          The above-described display of the invention provides flight information to assist the pilot in avoiding terrain collisions or making more efficient and safe  
15   landing approaches. The displays provide this information in a format that is relatively intuitive for the pilot to understand without substantial analysis, interpretation, false alarms, or unnecessary distraction from other duties, and conforms to standard graphical depictions used on approach charts and other places in the flight deck, thereby allowing the pilot to make any necessary adjustments to  
20   the speed and direction of the aircraft relatively quickly and precisely



## 5 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

Figure 1 illustrates one embodiment of a Vertical Profile Display providing a view of the vertical terrain along the track of the aircraft.

Figure 2 is a schematic of one embodiment of a terrain swath used to generate the vertical profile display.

10 Figure 3 illustrates a display that shows the terrain in the path of the turn, taking into account the aircraft's cross track acceleration, in which case the boundary of the swath also rotates away from the track line with the origin of the aircraft as the rotation point.

Figure 4 illustrates a vertical situation display having a triangular-shaped icon  
15 positioned towards the left side of the display, which represents the aircraft.

Figures 5, 6, and 7 illustrate one embodiment of a display that gives the pilot information about the location at which the aircraft will reach a target speed.

Figure 8 shows a display with a collection of points where the target speed will be achieved at various angles.

20 Figure 9 illustrates an embodiment of a display wherein the range-to-target speed symbol is located on the flight vector on a navigation display.

Figure 10 illustrates an embodiment of a display wherein the range-to-target speed symbol is located on the flight vector on a three-dimensional perspective map.

Figure 11 illustrates an embodiment of a display wherein the range-to-target  
25 speed symbol is located on head up display.

## 5 DETAILED DESCRIPTION OF THE INVENTION

The flight information display of the first aspect of the invention specifies a region in front of the aircraft to show terrain, waypoints and runways, on a vertical profile display. The source of the information to  
10 generate the profile of the terrain display may come from, but is not limited to, an on-board computer having a database of topographical information or a ground mapping radar. A Vertical Profile Display (VPD), provides a view of the vertical plane along the track of the aircraft (see Figure 1), and may also display other information such as data on aircraft performance or target  
15 altitude information.

The terrain depicted on the display is the highest terrain that is within a specified swath of terrain along the direction of the airplane's track. Specifically, the terrain value depicted at any given distance from the airplane symbol is the maximum terrain height along an arc at that given distance  
20 centered on the airplane and bounded by the edges of the swath. The swath may be of any suitable width or shape, but preferably widens as the distance from the airplane increases to take into account any slight variations from a straight-line trajectory in the path of the airplane. Most preferably, the swath is approximately the shape of a triangle with a corner at the nose of the  
25 airplane. In one embodiment, the projected swath also includes terrain in the direction of a turn because the swath preferably widens in the direction of any turns. In this embodiment, an algorithm calculates the swath to be

- 5     projected and bases the width of the most distant part on the swath by the sensed crosstrack acceleration.

          The width of the terrain used for input to generate the display is preferably at least about 0.15 nautical miles (nm), more preferably at least 0.30 nm. The width is also preferably at least the resolution of the terrain

10     database, most preferably at least the required navigation performance (RNP) for the current phase of flight or landing approach; but preferably no greater than 3 times the RNP for that phase of flight or approach, and more preferably no greater than 2 times the RNP for that phase of flight or approach. The distance in front of the aircraft depicted in the display is

15     preferably at least 0.5 nm. If the flight deck also contains on a separate top-down display of terrain in front of the airplane to the compass rose the distance depicted on the side-view display preferably at least half the range that is shown on the top-down display of terrain in front of the airplane to the compass rose; but is preferably no greater than 2 times the range. Most

20     preferably, the display's range is the same as the range that is shown on the map in front of the airplane to the compass rose.

          If the aircraft is on a straight path, the terrain swath used to generate the display is preferably in the shape of a rectangle with a tapered end at the nose of the aircraft. In one embodiment, from the nose of the aircraft to 2.5 nm in front of the

25     aircraft, the width of the terrain swath is 0.25 nm about the track of the aircraft (see Figure 2). From 2.5 nm to 5 nm, width of the terrain swath is preferably 0.75 nm about the track of the aircraft. From 5 nm to the edge of the displayed VSD range,

- 5 the width of the swath is preferably in the range of from 1 to 8 nm, as illustrated in Table 1.

| EFIS<br>RANGE | Preferred Swath<br>Width |
|---------------|--------------------------|
| 10 nm         | 1 nm                     |
| 20 nm         | 2 nm                     |
| 40 nm         | 4 nm                     |
| 80 nm         | 8 nm                     |
| 160 nm        | 8 nm                     |
| 320 nm        | 8 nm                     |
| 640 nm        | 8 nm                     |

Table 1. Width of 5 nm to end of display section vs. range selection

10

The varying swath takes into account coarse display resolution of range map scale settings greater than 10 nm (see Table 1). For distances close to the aircraft (5 nm and less) the swath of the terrain shown is preferably relatively narrow. Further away from the aircraft, the display

15 shows the highest terrain in a larger swath.

In a preferred embodiment, if the aircraft is turning, the display shows the terrain in the path of the turn, taking into account the aircraft's cross track acceleration, in which case the boundary of the swath also rotates away from the track line with the origin of the aircraft as the rotation point (see

20 Figure 3). The left side of the swath will rotate left if the aircraft is turning left while the right side will stay straight along the current track. Then the right side of the swath will rotate right if the aircraft is turning right and the left side of the swath will stay straight along the current track. This gives a

5 wedge of the terrain in front of the aircraft. The side of the swath preferably rotates  $\phi/2$  degrees where  $\phi$  is the bank angle of a non-accelerated constant altitude turn that produces the current cross track acceleration.

The use of a relatively narrow swath of terrain to generate the display provides a terrain picture that has a more steady, filtered appearance than a  
10 display which only uses data from the line of terrain directly in front of the aircraft, while still showing relevant terrain in front of the aircraft. Preferably, waypoints in this swath are also shown.

In the display of the second aspect of the invention, a vertical situation display includes a depiction of the glide slope of an approach for a  
15 runway when the aircraft is in a landing approach for the particular runway. The display also depicts the current angle of descent of the aircraft as a projected flight path on the display. If the aircraft is not within the glideslope for the runway, this type of display allows the pilot to directly see the extent to which the descent angle needs to be corrected. Figure 4  
20 illustrates a vertical situation display. On the bottom portion of the display, a triangular-shaped icon 41 is positioned towards the left side of the display, which represents the aircraft. However, any shape of icon or reference symbol may be used. The flight direction of the aircraft is depicted from left to right of the aircraft icon, and a vertical elevation scale 42 on the left the  
25 side of the display provides information on the altitude of various points along the projected descent path. The glide slope is depicted as an overlay on the flight path of the aircraft using any suitable combination of lines or

5 symbols. Preferably, the glide slope 43 is depicted in the same way as it is depicted in the same manner as it is shown in a standard approach chart with which the pilot is familiar. Typically, the glide slope is depicted as having the shape of narrow triangle. Such approach and landing approach charts are specific to each runway and are available from several companies and  
10 organizations, such as Jeppesen and National Oceanic and Atmospheric Service.

In the flight information display of the third aspect of the invention, a range-to-target speed symbol on the display automatically provides flight information in an operationally intuitive manner. This symbol can be shown  
15 on any type of flight deck display that shows the horizontal path of aircraft in any form, and may be any type of symbol that indicates the position or time where the selected speed will be achieved. The flight path vector can be colored to indicate this information on the primary flight information display, navigation display, or vertical situation awareness displays. There is no limit  
20 to how this information is depicted on the various displays. The range-to-target speed information is shown symbolically instead of textually to provide the pilot a clear and intuitive picture of the aircraft's situation. Examples of types of displays which may incorporate this type of symbol include vertical profile displays, primary flight information displays, navigation displays, head  
25 up displays, perspective displays/virtual reality displays, and three-dimensional displays.

5           A symbol on the display of the vertical flight path of the aircraft indicates the position along the vertical flight path vector where the current airspeed is predicted to equal the selected airspeed, given the current performance of the aircraft. Any symbol or icon may be utilized, but in one preferred embodiment, the flight path of the aircraft is shown as a white or  
10   light-colored vector emanating from the nose of the aircraft symbol, and the position at which the aircraft will reach the target speed is shown as a darker-colored dot (for example, a green dot) at a position along the vector. As a pilot initiates an approach to the airport, he must achieve the correct flight path and be at appropriate airspeeds before reaching a "final" position at  
15   which the pilot must decide whether to land or abort the landing and circle around to make another approach. The range-to-speed dot allows the pilot to assess the status of the descent and to recognize earlier situations that if uncorrected may lead to aircraft damage. A high speed landing while on path can result in a tailstrike, runway over runs, or hard landings resulting in  
20   airframe damage and possible injury to passengers. Avoiding these situations will save the airline from lost revenue and repair expenses that would result from approach and landing incidents.

          Although there can be many different ways of showing this position and related data, one preferred way of showing this position is by a  
25   filled/unfilled circle along the flight path. If the difference between the actual speed and target speed is less than a specified maximum, such as 5 knots, then the dot will be at the nose of the aircraft symbol as shown in Figure 5.

5 This is one type of hysteresis that can be used so that the dot will act smoothly to changes in aircraft performance when nearing the target speed. If the speed difference is greater than the specified maximum but is converging to that number, the position where the target speed will be achieved is represented on the display as a filled green circle, if the aircraft is projected to reach that speed at a distance no greater than the range of the display, as shown in FIG. 6. If the speed difference is not converging to the specified maximum or the location where the target speed will be achieved is outside the range of the display, then the filled green circle becomes a larger unfilled circle and is positioned at the edge of the display along the predicted flight path as shown in Figure 7. By keeping the symbol on the display, the pilot will always be aware of the aircraft's speed situation and trend. Figure 8 shows a display having several dots, each of which indicate the location at which the aircraft 1 will achieve the target speed at various flight angles. For example, at flight path 3 having flight angle 2, the target speed will be achieved at point 4. At flight path 5, the target speed will be achieved at point 6. If desired, a line 7 may connect the dots, a target speed/distance may be selected, and the flight angle/acceleration necessary to achieve the target speed/distance may be determined.

The dot's position on the display is calculated (Equation 1), using  
25 groundspeed, inertial acceleration, and the time it takes to achieve the selected airspeed. Groundspeed and inertial acceleration are used to calculate the position because the display is referenced to the ground and the



5 aircraft. The dot's vertical position is calculated in Equation 2 using vertical speed, current airspeed acceleration, and time to achieve the selected airspeed. Sensors measure groundspeed and inertial acceleration, but not time or airspeed acceleration. Therefore, the invention calculates the time to achieve the selected speed in Equation 3 using selected airspeed, current

10 airspeed, and current airspeed acceleration. Selected airspeed is an input from the pilot or flight management computer and current airspeed is a measured value. Current airspeed acceleration is calculated in Equation 4 by dividing the change in airspeed by the change in time. The calculated position information is then scaled to the display settings to depict the

15 correct position on the display.

$$d_{\text{achieve}} = v_{g_{\text{current}}} * (t_{\text{achieve}} / 3600) + (1/2 * a_g * \cos(\gamma) * t_{\text{achieve}}^2) / 6067 \text{ Eq. [1]}$$

$$h_{\text{achieve}} = v_{s_{\text{current}}} * (t_{\text{achieve}} / 60) + 1/2 * a_{\text{current}} * \sin(\gamma) * t_{\text{achieve}}^2 \text{ Eq. [2]}$$

$$t_{\text{achieve}} = ((v_{\text{selected}} - v_{\text{current}}) * 6067) / (3600 * a_{\text{current}}) \text{ Eq. [3]}$$

$$20 \quad a_{\text{current}} = ((v_{\text{final}} - v_{\text{initial}}) * 6067) / (3600 * (t_{\text{final}} - t_{\text{initial}})) \text{ Eq. [4]}$$

where: a = airspeed acceleration in ft/sec<sup>2</sup>; v = calibrated airspeed in knots; t = time in seconds; d = distance along the ground in nm; h = height in feet; vg = Ground Speed in knots; vs = Vertical Speed in ft/min; ag = Inertial acceleration along  $\gamma$  in units of g (32 ft/sec<sup>2</sup>);  $\gamma$  = Flight Path Vector in

25 degrees

5     Airspeed acceleration does not have to be an unfiltered instantaneous current  
airspeed acceleration as defined by Equation 4; averaging the data over a  
short period of time will produce a more steady moving symbol.

          This invention can be further utilized to provide a collection of points  
where the target speed will be achieved at various flight angles. As shown in  
10    figure 13, at flight angle 1 the selected speed will be achieved at A and at  
flight angle 2 the selected speed will be achieved at B, etc. All these points  
at various flight angles will produce a straight line in on the display. To  
generate this line or a set of dots, the acceleration needs to be predicted at  
the various flight angles. This line would enable one to see how to make  
15    trade-offs between airspeed and altitude.

          The range-to-target speed symbol can be located on the flight vector  
on a vertical situation awareness display (Figure 1), navigation display (dot  
91 on Figure 9), three-dimensional perspective map (dot 101 on Figure 10),  
head up displays (dot 111 on Figure 11), or any type of virtual reality flight  
20    information display. The information can be displayed so that the symbology  
provides an estimate of where the pilot will achieve the target speed along  
the flight plan instead of the flight path.

          The fourth aspect of the invention is a blended moving/fixed aircraft  
reference symbol. The aircraft symbol (white aircraft in Figure 1) begins at  
25    the bottom of the display (on top of the horizontal gray shade) when the  
aircraft is on the ground. The bottom altitude of the display is defined to be  
the take off field elevation during the take off portion and the landing field

5 elevation during the landing portion of flight. When the aircraft takes off, the aircraft will move vertically up along the altitude scale until it reaches a fixed point the top half of the display, preferably about two-thirds of the distance from the bottom of the display. At that point the aircraft is positioned at fixed on the display and the scale and background data move down away  
10 from the aircraft symbol as the aircraft climbs. The opposite is true for the descent case. The aircraft symbol stays fixed point on the display until the landing field elevation altitude reaches the bottom of the display. When the landing field elevation altitude becomes even with the bottom of the display, then the aircraft symbol moves down toward the landing field elevation  
15 altitude. The algorithms are straightforward as is the logic that switches between the vertically moving and the vertically fixed aircraft symbol. The aircraft is always fixed horizontally, adjacent to the left or right side of the display. The motion of the aircraft display allows the display to be relatively small and yet retain a high level of utility. This saves valuable display space,  
20 room in the cockpit that would be taken up by another display screen, and allows other pieces of information to remain visible to the pilot.

All of the visual displays of the invention may be electronically generated by any suitable means for converting electronic flight and terrain information, and any other data as appropriate, into a cockpit  
25 visual display having the above-described criteria and features. Example of electronic flight information systems that generate alarms and/or display

5 other types of flight information, or have other formats, are described in US

Patent Nos. 5,936,552, 5,839,080; 5,884,222; and 5,638,282.

10

## CLAIMS

1. A flight information display for the flight deck of an aircraft showing a side view of the flight path or the area directly in front of the aircraft area having a selected distance of at least 0.5 nautical miles, comprising (a) a pictorial representation to scale of the profile of the highest elevations of a swath of terrain along said path or area, (b) an icon positioned on the left or right side of the display representing the aircraft, the altitude of which is to scale with the height of the terrain, and (c) an altitude reference scale;

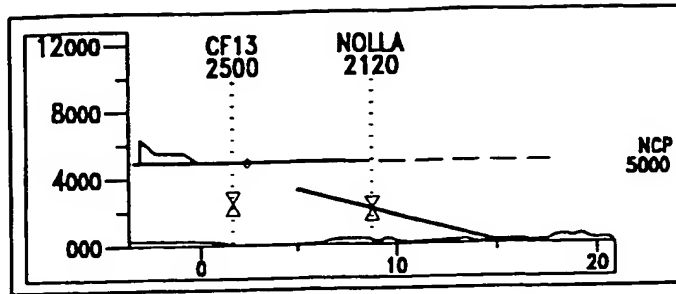
wherein the width of the swath is at least 0.1 nautical miles and no greater than the distance of the minimum accuracy of the means for determining the aircraft's location.

2. A flight information display for the flight deck of an aircraft showing a side view of the landing approach for the aircraft on a runway, comprising (a) a pictorial representation to scale of the profile of the current projected path of the descent of the aircraft, (b) a pictorial representation to the same scale of the profile of the vertical glide slope of the approach plate, (c) an icon positioned on the left or right side of the display representing the aircraft; the altitude of which is depicted to the same scale, and (d) a altitude reference scale.

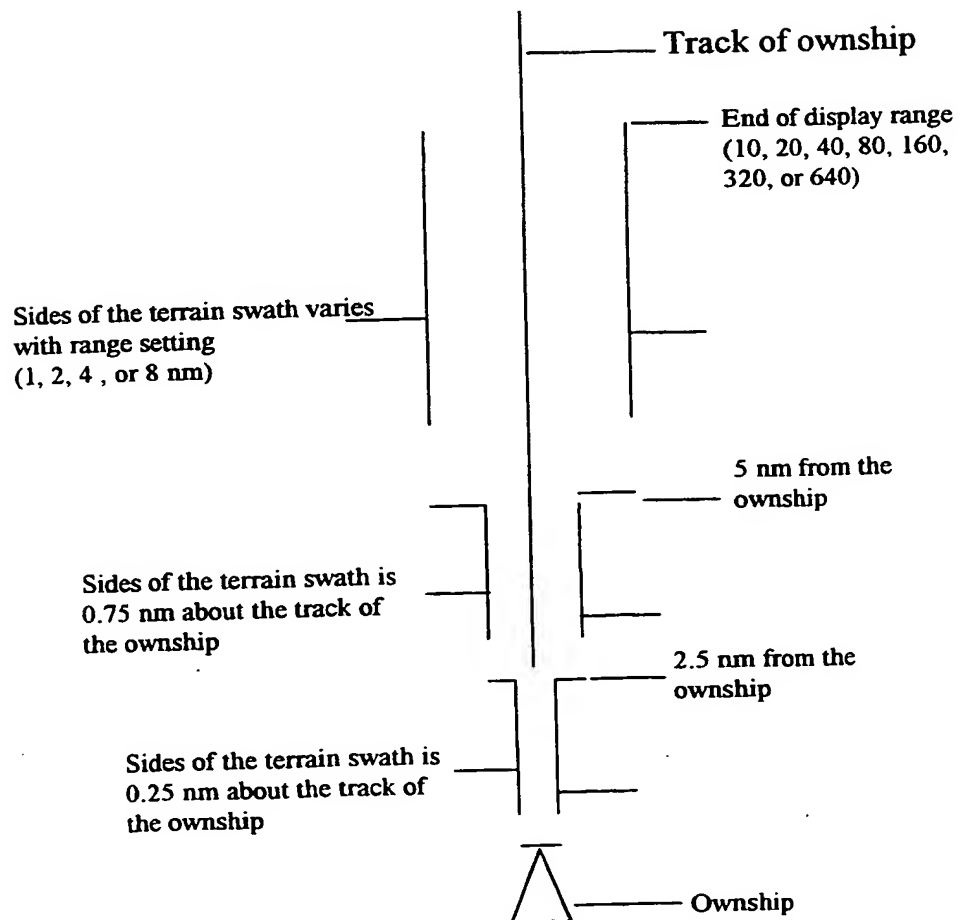
3. A flight information display for the flight deck of an aircraft comprising (a) a fixed reference point or icon representing the current location of the aircraft, (b) a pictorial representation of at least 0.5 nm of the profile of the projected flight path of the aircraft, (c) a an icon showing the location at which the aircraft will reach a target speed based on its current

speed and acceleration. This display provides an indication of where in the vertical plane and along the flight path the target speed will be achieved.

4. A flight information display for the flight deck of an aircraft, which comprises (a) an icon having a fixed position on the left side of the display representing the aircraft; (b) a vertical altitude scale which changes as the altitude of the aircraft changes so that the altitude number horizontally aligned with the aircraft icon is the current altitude of the aircraft and aircraft icon is located vertically along the altitude reference scale while always being in view, and (c) a pictorial representation of a lateral view of any terrain directly in front of the aircraft.



*Fig. 1*



**FIGURE 2. SIDES OF THE TERRAIN SWATH FROM THE 5 NM TO END OF THE DISPLAY RANGE FROM A TOP DOWN VIEWPOINT**

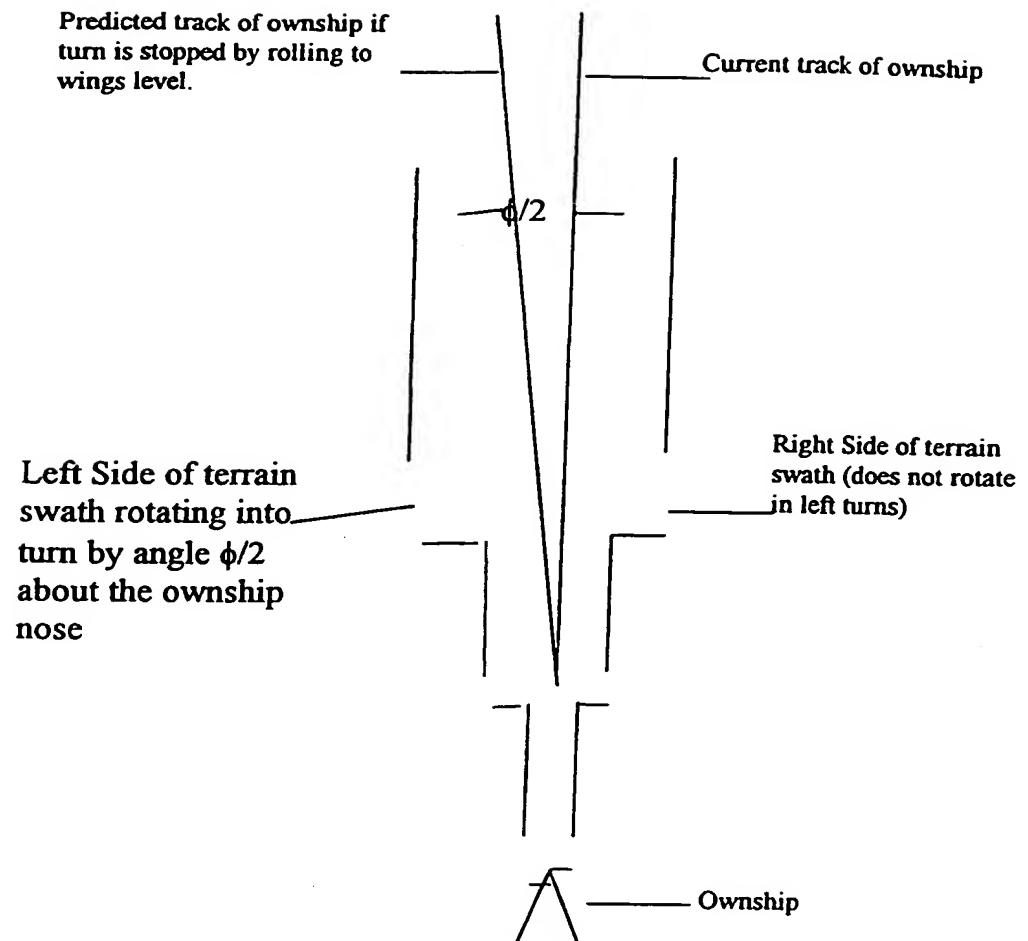
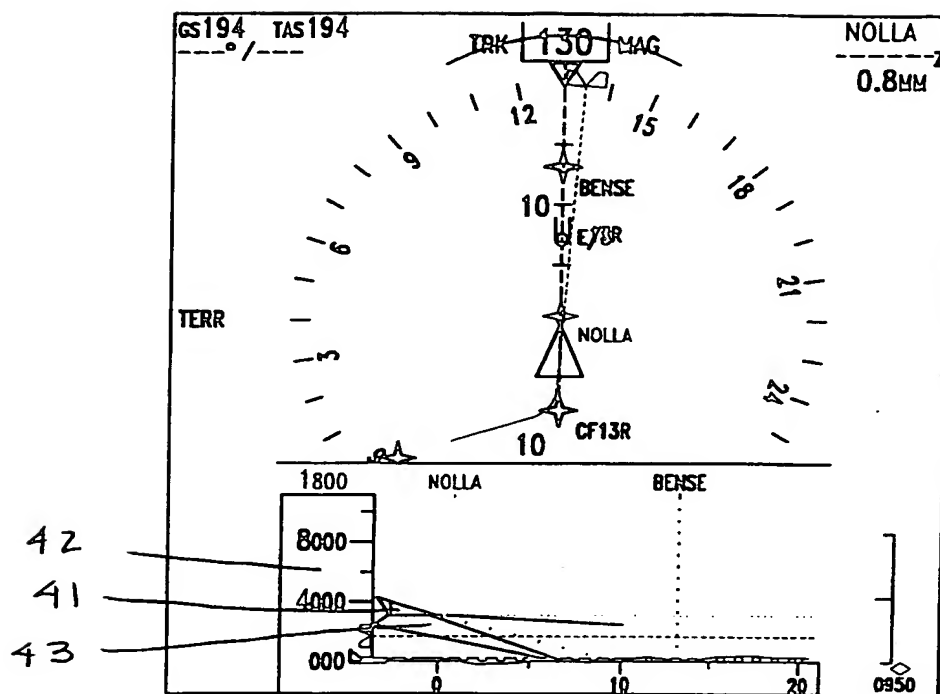
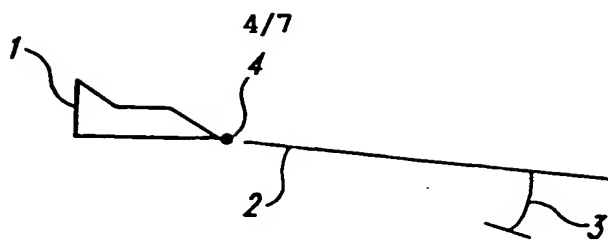


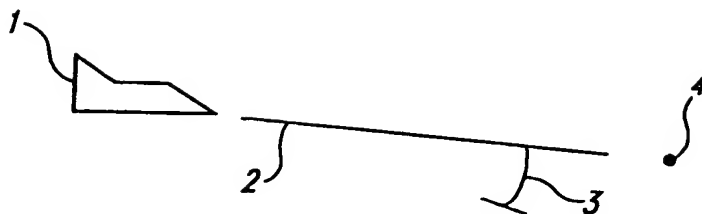
FIGURE 3. SIDES OF THE TERRAIN SWATH DURING A LEFT TURN FROM A TOP DOWN VIEWPOINT



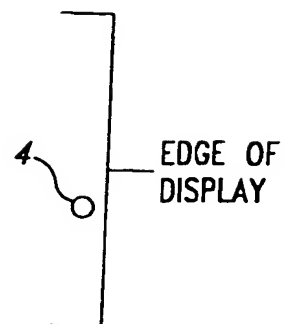
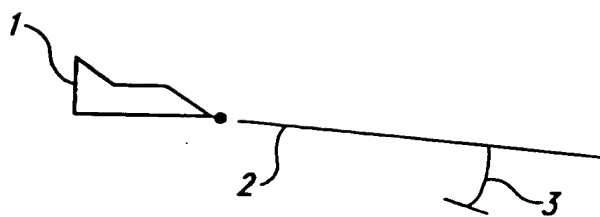
*Fig. 4*



*Fig. 5*



*Fig. 6*



*Fig. 7*

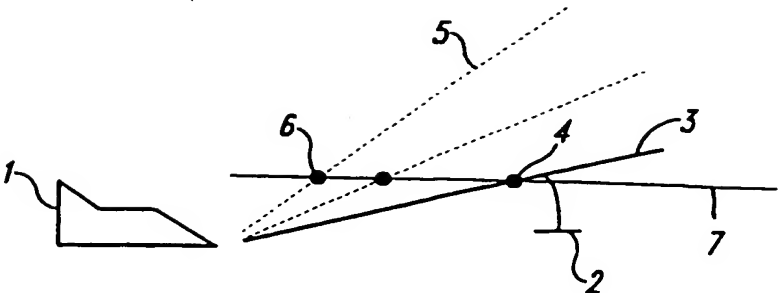


Fig. 8

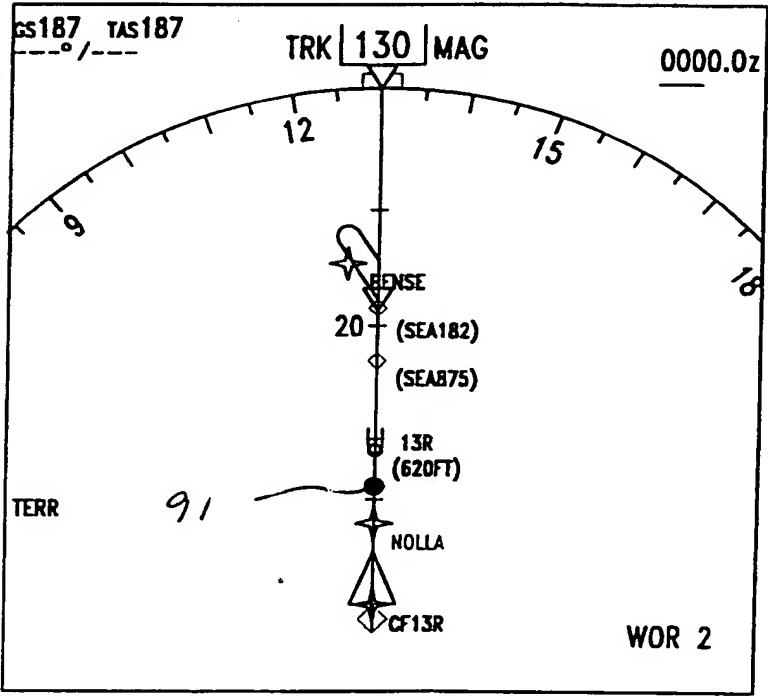
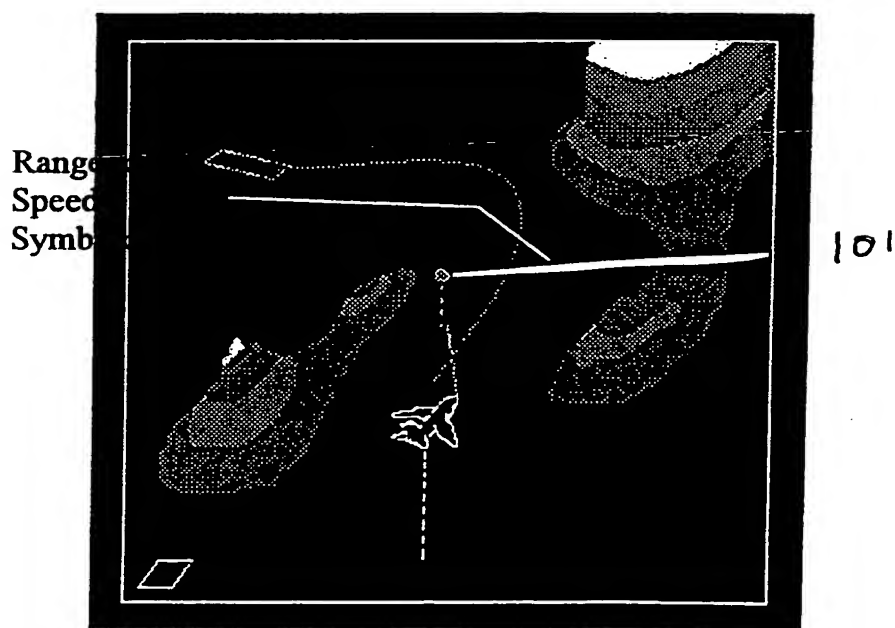


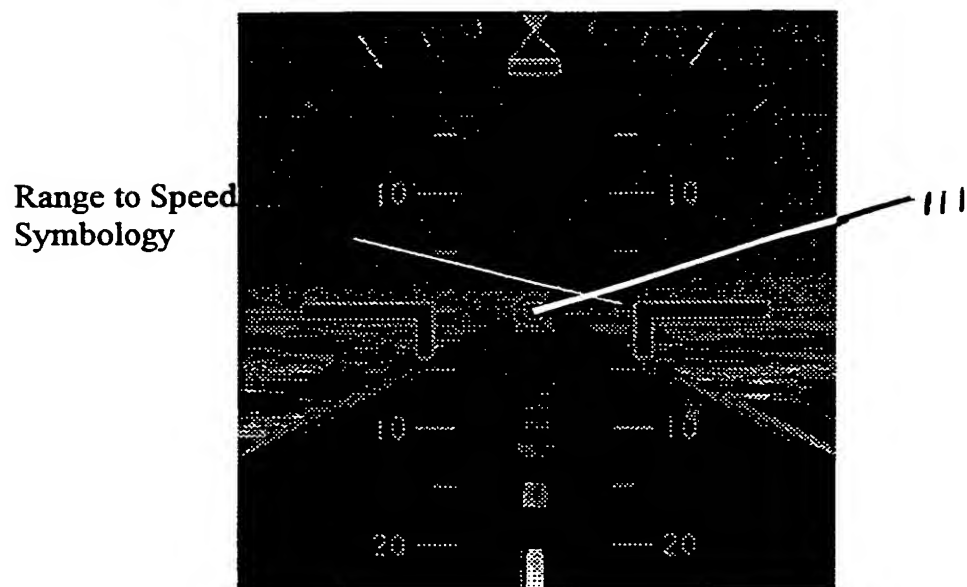
Fig. 9

5



10

Figure 10. 3D Perspective Map with Range to Speed Dot



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**Figure 11. Perspective Display / Virtual Reality Display**

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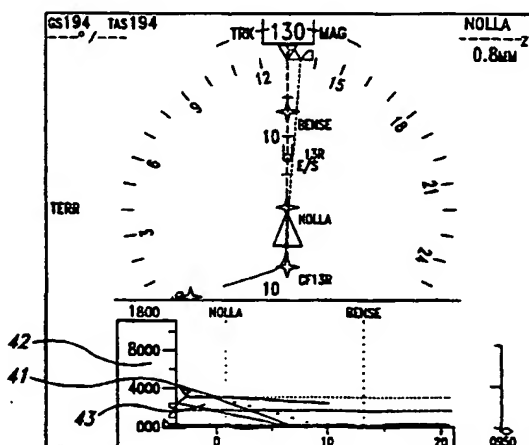
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60/146,489                      30 July 1999 (30.07.1999)    **US**
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- (74) Agent: **GALBRAITH, Ann, K.; The Boeing Company, P.O. Box 3707, M/S 13-08, Seattle, WA 98124-2207 (US).**
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(54) Title: **FLIGHT INFORMATION DISPLAY**



(57) Abstract: A flight information display for the flight deck of an aircraft showing a pictorial side view of the flight path or the area directly in front of the aircraft area having a selected distance of at least 0.5 nautical miles, comprising (a) a pictorial representation to scale of the profile of the highest elevations of a swath of terrain along said path or area, (b) an icon positioned on the left or right side of the display representing the aircraft, the altitude of which is to scale with the height of the terrain, and (c) an altitude reference scale; wherein the width of the swath is at least 0.1 nautical miles and no greater than the distance of the minimum accuracy of the means for determining the aircraft's location.

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/JS 00/20451

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G08G5/02 G08G5/04

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G08G G05D G01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                   | Relevant to claim No. |
|------------|--|-----------------------|
| Y          | US 4 283 705 A (JAMES ROBERT ET AL)<br>11 August 1981 (1981-08-11)<br>figure 1                       | 1-4                   |
| Y          | US 5 445 021 A (CATTOEN THIERRY ET AL)<br>29 August 1995 (1995-08-29)<br>column 2, line 61 - line 65 | 1-4                   |
| A          | DE 35 46 116 A (MUELLER HEINZ)<br>25 June 1987 (1987-06-25)  |                       |
| A          | US 5 289 185 A (RAMIER ALAIN ET AL)<br>22 February 1994 (1994-02-22)                                 |                       |
| A          | EP 0 324 195 A (BOEING CO)<br>19 July 1989 (1989-07-19)  |                       |
|            | ---<br>-/--  |                       |

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Fax: (+31-70) 340-3016

Authorized officer

Créchet, P

## INTERNATIONAL SEARCH REPORT

International Application No

PC, JS 00/20451

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                         | Relevant to claim No. |
|------------|--|-----------------------|
| A          | US 5 839 080 A (MULLER HANS R ET AL)<br>17 November 1998 (1998-11-17)<br>-----                             |                       |
| P, X       | US 5 936 552 A (WICHGERS JOEL M ET AL)<br>10 August 1999 (1999-08-10)<br>the whole document<br>-----       | 1-4                   |
| E          | US 6 154 151 A (MCELREATH KENNETH W ET<br>AL) 28 November 2000 (2000-11-28)<br>the whole document<br>----- | 1-4                   |



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCI, JS 00/20451

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| US 4283705                                | A | 11-08-1981          | NONE                       |                     |
| US 5445021                                | A | 29-08-1995          | FR 2689231 A               | 01-10-1993          |
| DE 3546116                                | A | 25-06-1987          | NONE                       |                     |
| US 5289185                                | A | 22-02-1994          | FR 2666428 A               | 06-03-1992          |
| EP 0324195                                | A | 19-07-1989          | US 4860007 A               | 22-08-1989          |
|   |   |                     | DE 3850088 D               | 14-07-1994          |
|   |   |                     | DE 3850088 T               | 15-09-1994          |
| US 5839080                                | A | 17-11-1998          | EP 0842396 A               | 20-05-1998          |
|   |   |                     | US 6088634 A               | 11-07-2000          |
|   |   |                     | US 6219592 B               | 17-04-2001          |
|   |   |                     | WO 9705450 A               | 13-02-1997          |
|   |   |                     | US 6122570 A               | 19-09-2000          |
|   |   |                     | US 6138060 A               | 24-10-2000          |
| US 5936552                                | A | 10-08-1999          | NONE                       |                     |
| US 6154151                                | A | 28-11-2000          | NONE                       |                     |

PCT

## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference  
(if desired) (12 characters maximum) 99-137

## Box No. I TITLE OF INVENTION

VERTICAL SITUATION DISPLAY TERRAIN/WAYPOINT SWATH, RANGE TO TARGET SPEED, AND BLENDED AIRPLANE REFERENCE

## Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

THE BOEING COMPANY  
P.O. Box 3707, M/S 13-08  
Seattle, Washington 98124-2207  
United States of America

☐ This person is also inventor.Telephone No.  
(206) 544-1027Facsimile No.  
(206) 655-5076

Teleprinter No.

State (that is, country) of nationality:  
USState (that is, country) of residence:  
US

This person is applicant for the purposes of: ☒ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

## Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

CHEN, Sherwin S.  
12601 SE 41st Pl.  
Apt. C101  
Bellevue, Washington 98006  
United States of America

This person is:

☐ applicant only☒ applicant and inventor☐ inventor only (If this check-box is marked, do not fill in below.)State (that is, country) of nationality:  
USState (that is, country) of residence:  
US

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

## Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

☒ agent ☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

GALBRAITH, Ann K.

Telephone No.

Facsimile No.

Teleprinter No.

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

**Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTOR(S)**

*If none of the following sub-boxes is used, this sheet is not to be included in the request.*

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

FOX, Julianne M.  
The Boeing Company  
P.O. Box 3707, M/S 13-08  
Seattle, Washington 98124-2207  
United States of America

This person is:

- ☐ applicant only  
☒ applicant and inventor  
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:  
US

State (that is, country) of residence:  
US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

MOLLOY, Neal D.  
11519 Pine Ct.  
Mukilteo, Washington 98275  
United States of America

This person is:

- ☐ applicant only  
☒ applicant and inventor  
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:  
US

State (that is, country) of residence:  
US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

WIEDEMANN, John  
11024 NE 197th St.  
Bothell, Washington 98011  
United States of America

This person is:

- ☐ applicant only  
☒ applicant and inventor  
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:  
US

State (that is, country) of residence:  
US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

- ☐ applicant only  
☐ applicant and inventor  
☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

**Box No.V DESIGNATION OF STATES**

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

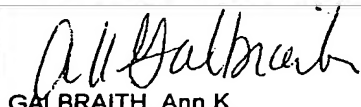
**Regional Patent**

- ☒ **AP ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line) .....

**National Patent (if other kind of protection or treatment desired, specify on dotted line):**

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> AE United Arab Emirates                  | <input checked="" type="checkbox"/> LR Liberia   |
| <input checked="" type="checkbox"/> AL Albania                               | <input checked="" type="checkbox"/> LS Lesotho   |
| <input checked="" type="checkbox"/> AM Armenia                               | <input checked="" type="checkbox"/> LT Lithuania   |
| <input checked="" type="checkbox"/> AT Austria                               | <input checked="" type="checkbox"/> LU Luxembourg  |
| <input checked="" type="checkbox"/> AU Australia                             | <input checked="" type="checkbox"/> LV Latvia  |
| <input checked="" type="checkbox"/> AZ Azerbaijan                            | <input checked="" type="checkbox"/> MA Morocco   |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina                | <input checked="" type="checkbox"/> MD Republic of Moldova   |
| <input checked="" type="checkbox"/> BB Barbados                              | <input checked="" type="checkbox"/> MG Madagascar  |
| <input checked="" type="checkbox"/> BG Bulgaria                              | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia                             |
| <input checked="" type="checkbox"/> BR Brazil                                |  |
| <input checked="" type="checkbox"/> BY Belarus                               | <input checked="" type="checkbox"/> MN Mongolia  |
| <input checked="" type="checkbox"/> CA Canada                                | <input checked="" type="checkbox"/> MW Malawi  |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein  | <input checked="" type="checkbox"/> MX Mexico  |
| <input checked="" type="checkbox"/> CN China                                 | <input checked="" type="checkbox"/> NO Norway  |
| <input checked="" type="checkbox"/> CR Costa Rica                            | <input checked="" type="checkbox"/> NZ New Zealand   |
| <input checked="" type="checkbox"/> CU Cuba                                  | <input checked="" type="checkbox"/> PL Poland  |
| <input checked="" type="checkbox"/> CZ Czech Republic                        | <input checked="" type="checkbox"/> PT Portugal  |
| <input checked="" type="checkbox"/> DE Germany                               | <input checked="" type="checkbox"/> RO Romania   |
| <input checked="" type="checkbox"/> DK Denmark                               | <input checked="" type="checkbox"/> RU Russian Federation  |
| <input checked="" type="checkbox"/> DM Dominica                              | <input checked="" type="checkbox"/> SD Sudan   |
| <input checked="" type="checkbox"/> EE Estonia                               | <input checked="" type="checkbox"/> SE Sweden  |
| <input checked="" type="checkbox"/> ES Spain                                 | <input checked="" type="checkbox"/> SG Singapore   |
| <input checked="" type="checkbox"/> FI Finland                               | <input checked="" type="checkbox"/> SI Slovenia  |
| <input checked="" type="checkbox"/> GB United Kingdom                        | <input checked="" type="checkbox"/> SK Slovakia  |
| <input checked="" type="checkbox"/> GD Grenada                               | <input checked="" type="checkbox"/> SL Sierra Leone  |
| <input checked="" type="checkbox"/> GE Georgia                               | <input checked="" type="checkbox"/> TJ Tajikistan  |
| <input checked="" type="checkbox"/> GH Ghana                                 | <input checked="" type="checkbox"/> TM Turkmenistan  |
| <input checked="" type="checkbox"/> GM Gambia                                | <input checked="" type="checkbox"/> TR Turkey  |
| <input checked="" type="checkbox"/> HR Croatia                               | <input checked="" type="checkbox"/> TT Trinidad and Tobago   |
| <input checked="" type="checkbox"/> HU Hungary                               | <input checked="" type="checkbox"/> TZ United Republic of Tanzania   |
| <input checked="" type="checkbox"/> ID Indonesia                             | <input checked="" type="checkbox"/> UA Ukraine   |
| <input checked="" type="checkbox"/> IL Israel                                | <input checked="" type="checkbox"/> UG Uganda  |
| <input checked="" type="checkbox"/> IN India                                 | <input checked="" type="checkbox"/> US United States of America  |
| <input checked="" type="checkbox"/> IS Iceland                               |  |
| <input checked="" type="checkbox"/> JP Japan                                 | <input checked="" type="checkbox"/> UZ Uzbekistan  |
| <input checked="" type="checkbox"/> KE Kenya                                 | <input checked="" type="checkbox"/> VN Viet Nam  |
| <input checked="" type="checkbox"/> KG Kyrgyzstan                            | <input checked="" type="checkbox"/> YU Yugoslavia  |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | <input checked="" type="checkbox"/> ZA South Africa  |
|  | <input checked="" type="checkbox"/> ZW Zimbabwe  |
| <input checked="" type="checkbox"/> KR Republic of Korea                     | Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet: |
| <input checked="" type="checkbox"/> KZ Kazakhstan                            | <input type="checkbox"/> .....   |
| <input checked="" type="checkbox"/> LC Saint Lucia                           | <input type="checkbox"/> .....   |
| <input checked="" type="checkbox"/> LK Sri Lanka                             |  |

**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and

| <b>Box No. VI PRIORITY CLAIM</b>  |                                  | <input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.   |  |  |
|---|----------------------------------|---|--|--|
| Filing date<br>of earlier application<br>(day/month/year)   | Number<br>of earlier application | Where earlier application is:   |  |  |
|   |                                  | national application:<br>country  | regional application:<br>regional Office | international application:<br>receiving Office |
| item (1)<br>30/07/1999<br>30/JULY/1999  | 60/146,489                       |   |  |  |
| item (2)  |                                  |   |  |  |
| item (3)  |                                  |   |  |  |
| <input checked="" type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): (1) |                                  |   |  |  |
| <small>* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.</small>   |                                  |   |  |  |
| <b>Box No. VII INTERNATIONAL SEARCHING AUTHORITY</b>  |                                  |   |  |  |
| <b>Choice of International Searching Authority (ISA)</b><br>(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):   |                                  | <b>Request to use results of earlier search; reference to that search</b> (if an earlier search has been carried out by or requested from the International Searching Authority): |  |  |
| ISA/EP  |                                  | Date (day/month/year)      Number      Country (or regional Office)   |  |  |
| <b>Box No. VIII CHECK LIST: LANGUAGE OF FILING</b>  |                                  |   |  |  |
| This international application contains the following number of sheets:   |                                  | This international application is accompanied by the item(s) marked below:  |  |  |
| request :   | 4                                | 1. <input checked="" type="checkbox"/> fee calculation sheet  |  |  |
| description (excluding sequence listing part) :   | 18                               | 2. <input checked="" type="checkbox"/> separate signed power of attorney  |  |  |
| claims :  | 2                                | 3. <input checked="" type="checkbox"/> copy of general power of attorney, reference number, if any:   |  |  |
| abstract :  | 1                                | 4. <input type="checkbox"/> statement explaining lack of signature  |  |  |
| drawings :  | 7                                | 5. <input checked="" type="checkbox"/> priority document(s) identified in Box No. VI as item(s):  |  |  |
| sequence listing part of description :  |                                  | 6. <input type="checkbox"/> translation of international application into (language):   |  |  |
| Total number of sheets :  | 32                               | 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material  |  |  |
|   |                                  | 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form   |  |  |
|   |                                  | 9. <input type="checkbox"/> other (specify):  |  |  |
| Figure of the drawings which should accompany the abstract:   |                                  | Language of filing of the international application: ENGLISH  |  |  |
| <b>Box No. IX SIGNATURE OF APPLICANT OR AGENT</b>   |                                  |   |  |  |
| Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).  |                                  |   |  |  |
| <br>GALBRAITH, Ann K.  |                                  |   |  |  |

|   |  |  |
|---|--|--|
| For receiving Office use only   |  | 2. Drawings:<br><br><input type="checkbox"/> received:<br><br><input type="checkbox"/> not received: |
| 1. Date of actual receipt of the purported international application:   |  |  |
| 3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application: |  |  |
| 4. Date of timely receipt of the required corrections under PCT Article 11(2):  |  |  |
| 5. International Searching Authority (if two or more are competent): ISA/   | 6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid. |  |

|                                    |
|------------------------------------|
| For International Bureau use only  |
| Date of receipt of the record copy |

# PCT

## FEE CALCULATION SHEET

### Annex to the Request

For receiving Office use only

International application No.

Date stamp of the receiving Office

Applicant's or agent's  
file reference

99-137

Applicant

THE BOEING COMPANY

#### CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE .....

240.00

T

2. SEARCH FEE .....

1,250.00

S

International search to be carried out by ISA/EP

(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

#### Basic Fee

The international application contains 32 sheets.

first 30 sheets

455.00

b1

2

x

\$10.00

=

20.00

b2

remaining sheets additional amount

Add amounts entered at b1 and b2 and enter total at B

475.00

B

#### Designation Fees

The international application contains ALL designations.

10

x

105.00

=

1,050.00

D

number of designation fees payable (maximum 8) amount of designation fee

Add amounts entered at B and D and enter total at I

1,525.00

I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

0.00

P

4. FEE FOR PRIORITY DOCUMENT (if applicable) .....

5. TOTAL FEES PAYABLE .....

3,015.00

Add amounts entered at T, S, I and P, and enter total in the TOTAL box

TOTAL

☐ The designation fees are not paid at this time.

#### MODE OF PAYMENT

☒ authorization to charge  
deposit account (see below)

☐ bank draft

☐ coupons

☐ cheque

☐ cash

☐ other (specify):

☐ postal money order

☐ revenue stamps

#### DEPOSIT ACCOUNT AUTHORIZATION (this mode of payment may not be available at all receiving Offices)

The RO/ US

☒ is hereby authorized to charge the total fees indicated above to my deposit account.

☒ (this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☒ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

*17 APR*

PCT

POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCT Rule 90.4)

The undersigned applicant(s) (Names should be indicated as they appear in the request):

CHEN, Sherwin S.

FOX, Julianne M.

MOLLOY, Neal D.

WIEDMANN, John

hereby appoints (appoint) the following person as:

☒ agent

☐ common representative

Name and address

(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

CULLOM, Paul C. Jr.

GULLETTE, Robert L.

GALBRAITH, Ann K.

HAMLEY, James P.

HAMMAR, John C.

NELSON, Lawrence W.

RICHARDSON, Robert R.

Address of all: THE BOEING COMPANY  
P.O. Box 3707, M/S 13-08  
Seattle, Washington 98124-2207

to represent the undersigned before

☒ all the competent International Authorities

☐ the International Searching Authority only

☐ the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: VERTICAL SITUATION DISPLAY TERRAIN/WAYPOINT SWATH, RANGE TO  
TARGET SPEED, AND BLENDED AIRPLANE REFERENCE

Applicant's or agent's file reference: 99-137

International application number (if already available):

filed with the following Office RO/US as receiving Office  
and to make or receive payments on behalf of the undersigned.

Signature of the applicant(s) (where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power):

CHEN, Sherwin S.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

FOX, Julianne M.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

MOLLOY, Neal D.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

WIEDEMANN, John

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

PCT

GENERAL POWER OF ATTORNEY

(for several international applications filed under the Patent Cooperation Treaty)

(PCT Rule 90.5)

The undersigned person(s):  
(Family name followed by given name; for a full legal entity, full official designation. The address must include postal code and name of country.)

GULLETTE, ROBERT L.  
Assistant Secretary to  
THE BOEING COMPANY  
P.O. Box 3707, M/S 13-08  
Seattle, Washington 98124-2207  
United States of America

hereby appoint(s) the following person as:

☒ agent

☐ common representative

Name and address  
(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

CULLOM, Paul C. Jr.  
HAMLEY, James P.  
FIELD, Harry B.  
HERRERA, Carlos M.

GULLETTE, Robert L.  
HAMMAR, John C.  
NELSON, Lawrence W.  
SILBERBERG, Charles T.

GALBRAITH, Ann K.  
GINSBERG, Lawrence N.  
RICHARDSON, Robert R.

Address of all: THE BOEING COMPANY  
P.O. Box 3707, M/S 13-08  
Seattle, Washington 98124-2207

to represent the undersigned before

☒ all the competent International Authorities

☐ the International Searching Authority only

☐ the International Preliminary Examining Authority only

in connection with any and all international applications filed by the undersigned with the following Office

US/RO

as receiving Office

and to make or receive payments on behalf of the undersigned.

Signature(s) (where there are several persons, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading this power):

ROBERT L. GULLETTE  
Assistant Secretary to  
The Boeing Company

Date: 04/May/2000